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PROFESSIONAL APTITUDE TESTS
IN
MEDICINE, LAW,
AND ENGINEERING

PROFESSIONAL APTITUDE
TESTS
IN MEDICINE, LAW, AND
ENGINEERING

B₂

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Introduction

THE LAST TWO DECADES have witnessed the emergence of a widespread movement for vocational guidance. The last five years seem to indicate that vocational guidance without an adequate consideration of socio-economic conditions can make but little contribution to a solution of one of the most perplexing problems which now confront the world and youth in particular. There are, however, a few fields in which guidance can be conducted with some promise of success; these fields are more specifically recognized as professions, which require somewhat lengthy preparation. This fact alone operates as a method of selection—only those who can afford the time and money involved in such preparation can be expected to enter upon it. And yet from the point of view both of the individual student and of service to society, something more than this haphazard method of selection is needed. The individual student should be protected against “disappointment, disillusionment, and waste” of failure after being admitted to an institution for professional preparation. The interests of society should be safeguarded against inefficient practitioners by the maintenance of

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adequate standards. Institutions for professional preparation thus have a twofold duty and in addition ought to consider the waste of their own resources through failure to discriminate adequately between those who show promise and those who do not.

There are three professions—medicine, law, and engineering—in which efforts have been made with varying degrees of comprehensiveness and success to set up selective standards of admission to the preparatory stage. These efforts have been undertaken because of a recognition of the high percentage of failures among students admitted to the professional institutions concerned. The question of admission to the professions cannot wholly be solved by methods at present available for selecting candidates for admission to these institutions. All that can be claimed for the present is that measures are available for the selection of candidates who under existing conditions show promise of success in the studies required as a preparation for admission to a profession. There are too many imponderables which make for success in practice; it may in the future perhaps be possible to subject these imponderables to objective measurement and prediction. At the present stage of development it can be claimed that promise of success in studies can be gauged in advance. This is in general true of medical studies, where the use of objective tests as one criterion—but only one of several criteria—has become generalized. It is true for the study of law in a few institutions. In engineering education measures are available but have not yet been standardized or generally employed for purposes of admission.

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In the efforts to develop objective measures for the admission of candidates to professional study there has been, in addition to an expressed desire to exclude those who do not show promise of success, a tendency to consider the whole problem in terms of the number of practitioners whose services are likely to be needed by society, or, to put it in other words, to maintain high standards of admission and at the same time avoid the danger of intensifying competition within the professions concerned. While no one would deny the danger of an overproduction of professionally trained men and women—most of the European countries have experienced the reality of this danger¹—little consideration has yet been given to the questions whether the distribution of professional services is adequate in a country like the United States, and whether expanding social requirements may not need more professionally trained men and women than are at present available. To avoid a consideration of these questions means, on the one hand, a limitation of the number of candidates either to existing institutional resources or to the immediate requirements, and, on the other hand, possibly laying the professions concerned open to the charge of a type of syndicalism which seeks to limit opportunities and advantages. These questions do not seem to have been discussed in the literature on professional aptitude tests which is at present available.

One important point which emerges from a survey of aptitude tests for professional study is that no claim is

¹ Kotschnig, W. M., *Unemployment in the Learned Professions*. London, 1937.

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made other than that already mentioned—that aptitude tests can only discover whether a candidate is likely to succeed in the professional preparation selected. They do not indicate promise of future success in the practice of that profession. Since the qualities and conditions that make for such success are yet unknown, the question still remains open whether candidates who on the basis of professional aptitude tests do not reveal abilities which show promise of success in the appropriate courses should be permitted to take them. In other words, should candidates be allowed to undertake studies when measures at present available indicate the probability of failure? Again, this question can only be answered in terms of justice to the individual himself and fairness to the professional institution itself when it is asked to use its resources in an attempt to provide an adequate preparation for those candidates whose lack of promise has been ascertained in advance. There is here involved a social as well as an educational issue. Those who would favor the admission of candidates despite the results of aptitude tests appear to rest their case on the traditional American principle of “giving every boy and girl a chance”—a principle which is described as “democratic.” Such a principle would seem to defeat the ends which aptitude tests seek to advance—the right education for the right individual. It is a relic of the days when standards of professional preparation and professional requirements were meager in the extreme. If aptitude tests mean anything—and it is not suggested that they have yet reached absolute perfection anywhere—they do point to another principle and that

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is that the interests of society come first and that professional institutions have the obligation to provide society with practitioners whose expert qualifications can be guaranteed.

It is clear from the investigation here presented that nowhere is the claim made that aptitude tests can be used as the only criterion for the admission of candidates to professional study, nor that any one standard of admission can be imposed on all professional institutions throughout the country. All that can be claimed is that here are measures which have proved their value for purposes of diagnosis and prognosis and which may be used as one criterion and an important criterion for purposes of admission. Only one study has been made in an attempt to prove that the aptitude test actually reveals ability to study for the profession concerned (medicine); more such studies are urgently needed. Until these further studies are made, the feeling may continue that aptitude tests reveal either general ability or the results of specialized preparation. On the latter point, however, evidence is accumulating of considerable dissatisfaction with pre-courses (premedical, pre-law, pre-engineering) and of an increasing demand for a broad, general education for all professional practitioners. If this evidence may be accepted, the development and use of aptitude tests become all the more urgent. The present study does not claim to be more than a record of what has been done in this area. No attempt has been made to undertake the more technical study of the validity and reliability of the tests used.

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The present study is a continuation of the author's investigation of objective measures, published by the Carnegie Foundation for the Advancement of Teaching as Bulletin Number Twenty-eight, *Examinations and Their Substitutes in the United States*. To the Carnegie Corporation of New York and to the Carnegie Foundation for the Advancement of Teaching the author desires to express his appreciation of the opportunity to investigate the use of aptitude tests in the professional fields.

I. L. K.

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Medicine

IN THE SELECTION OF CANDIDATES for the study of medicine greater progress has probably been made than for any other professional field. A number of causes have contributed to this. The medical profession is one of the most strongly organized bodies and within the profession itself there has developed the Association of American Medical Colleges; both groups are concerned with maintaining the standards of the training for and the practice of medicine. This fact alone would not have been enough to lead to concern about selection of prospective candidates. In the last thirty years the number of medical colleges in the United States has been considerably reduced, and, while the quality of the remainder has been improved, the reduction in number and the consequent limitation of accommodation and facilities inevitably pushed the problem of the selection of prospective students into the foreground. This situation has been accelerated in the last decade or more by a striking increase in the number of applicants for admission to medical schools. This increase has been due in part to the increase in the number of students attending college and

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looking to professional careers and in part to the economic situation and the decrease of opportunities for employment in industry and commerce. Even during the period of depression fluctuations in the economic situation have been reflected by fluctuations in the number of applicants. Further, each medical college insisted upon maintaining, within a general framework, its own standards and methods of admitting students.

The increase in the number of applicants was not the only factor that directed attention to the necessity of introducing some reliable methods of selection. It is not improbable that this increase was even anticipated by another fact—the realization of the high rate of mortality among the students, particularly in the first year of their medical course. A combination of the two conditions—increase in the number of applicants and high rate of student mortality—defined the problem as follows. It is not merely one of selecting from a certain group of applicants the number that could be accommodated, but of selecting from this group those who showed the greatest promise of completing the course so far as scholastic ability is concerned. The problem, in other words, was to devise one or more criteria which not only would select a body of students but would also have predictive value in so far as such criteria are possible or available.

A variety or combination of methods of selection had, of course, been developed, but the pressure of the situation demanded one or more methods whereby success in medical studies could be predicted. The standards of ad-

mission had been raised to a minimum of two years of college work, devoted generally to premedical studies. Personal interviews and letters of recommendation were employed, but with the knowledge that their value was not high. Admission by examinations was recognized as cumbersome and complex unless conducted by a central agency. Finally, there is a large number of imponderables of character and personality which are essential for the practice of all professions, and of medicine in particular, which must be taken into account. Yet with all these methods the result in practice was virtually that students were admitted on trial, as it were, and were gradually weeded out with the highest mortality in the first year and continued mortality at decreasing rates throughout the course. The problem was further aggravated by the fact that medical colleges draw their students from a variety of liberal arts colleges, some accredited and some not, and in any event representing, as shown in the Pennsylvania Study by the Carnegie Foundation, a wide variation of standards. Ordinary intelligence tests, it was felt, could not do more than give some information on the mental ability of applicants; they could not be expected to reveal special aptitude for the study and practice of medicine. Everything seemed to point in the direction of a measure which would reveal medical aptitude, which could be used in addition to other accepted methods of admission, and which, while it could be used on a nation-wide scale, would not restrict any institution in the adoption of a policy best adapted to its own situation.

The unreliability of empirical methods of admission

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was clearly brought out in 1929 by Dr. F. T. Van Beuren, Associate Dean of the College of Physicians and Surgeons, in an article on "Correlation of Grades in Medical and Premedical Work with Personality."¹ Analyzing the records of the class graduated in 1927 Dr. Van Beuren reported that the character of work which a student might be expected to do in medical school was indicated rather better by the average grade in all subjects taken in college than by the average of required pre-medical subjects alone. Practically all the students admitted with a grade under B had been selected purely on the basis of personality (references, interviews, college activities, and adequate funds to pursue the medical course). Of the class of 96 students 27 had been admitted with grades between C and C+, 40 with grades between C+ and B, 23 with grades between B and B+, and 6 with grades between B+ and A. At graduation two men were left in the C to C+ group, 48 in the C+ to B group, and 3 in the B+ to A group. At least a quarter of the class had climbed out of the low group into the middle or high.

Discussing this report Dr. W. C. Rappleye referred to a study of 600 physicians known to be doing a high type of medical service. Although the data were not altogether adequate, an investigation of their grades in medical schools showed that those who, in the opinion of fellow physicians, were successful in practice were about equally divided among the upper, middle, and lower divisions of their classes.

¹ *Journal of the Association of American Medical Colleges*, Vol. 4, pp. 199 ff., July, 1929.

Dr. Van Beuren's statement that the average grades of students in all college subjects had greater predictive value than average grades in premedical subjects was corroborated in 1931 by Dr. E. S. Thorpe, Jr., Assistant Dean of the School of Medicine of the University of Pennsylvania. In an article on the "Relative Value of Cultural Courses in Premedical Training"² Dr. Thorpe reported that an analysis of students enrolled over a period of five years showed that it is not necessary for a good student to prepare himself for a career in medicine by electing an inordinate amount of chemistry, biology, and physics in college. "Let us, therefore, demand merely that our students come to us really knowing the fundamental principles of science and the relation of science to other branches of knowledge." The same results were reported by W. F. Cramer in "A Study of the Selective Admission of Students in the Medical School of the University of Chicago."³ This study showed that there was a higher correlation between medical grades and grades in total premedical programs than between medical grades and grades in biological and other sciences. High scholarship in premedical education is closely associated with the attainment of honors in medical schools. "While there is some relationship between the amount of work taken in the natural sciences and success in the medical schools, the relationship is not high." Continued studies over a period of years by Dr. F. C. Zapffe, Secretary of the Association of American Medical Colleges, confirm these

² *Ibid.*, Vol. 6, pp. 79 ff., March, 1931.

³ *Ibid.*, Vol 8, pp. 347 ff., November, 1933.

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findings in another way through evidence that students who graduate with an A. B. degree are more successful in medical studies than those who graduate with the B. S. degree. On the other hand, this picture tends to be confused by the evidence produced by Dr. Zapffe that students admitted with only two years of college studies are a close second to the A. B.'s.

It might have been expected that such studies as those cited would furnish guides to better methods of selection. There are, however, certain reservations in these studies in the facts that each was limited to one institution, that a proportion (the numbers are not given) of those admitted had received their preparation in other divisions of the same institutions, that other measures than scholarship enter into selection, that college standards vary so greatly with the vast army of applicants to be considered, and that a more objective, accurate, and reliable measure is needed than college records.

Reports have been available on numbers of candidates and of applications for admission to medical colleges each year since 1928, with the exception of 1930 and 1931. The first reports were prepared by Dr. B. D. Myers, Dean of the School of Medicine of Indiana University; since 1933 they have been prepared by Dr. F. C. Zapffe. The magnitude of the problem may be gathered from the table on the following page.

It will be noticed that the number of multiple applicants shows an increase, while the number of single applicants is falling. Twelve candidates in 1937 made from 30 to 41 applications each; six out of the 403

NUMBER OF APPLICANTS AND ADMISSIONS¹

	1933	1934	1935	1936	1937
Applications	29,705	32,321	34,427	35,439	34,416
Applicants	12,128	12,779	12,740	12,192	12,207
Single applicants	7,269	7,623	7,231	6,657	6,564
Single applicants accepted	4,434 (60.9%)	4,433 (58.1%)	3,980 (55.4%)	3,538 (53.1%)	3,423 (52.1%)
Single applicants rejected	2,835	3,190	3,251	3,119	3,141
Multiple applicants	4,859	5,156	5,509	5,535	5,643
Multiple applicants accepted	3,109 (63.1%)	2,986 (57.9%)	2,920 (53%)	2,927 (52.8%)	2,987 (52.9%)
Multiple applicants rejected	1,750	2,170	2,589	2,608	2,656
Total accepted	7,548 (62.1%)	7,419 (57.9%)	6,900 (54.1%)	6,465 (53%)	6,410 (52.5%)
Total rejected	4,585	5,360	5,840	5,727	5,797

¹ Zapffe, F. C., "Study of Applicants for Admission to the 1937 Freshman Class of 78 Medical Colleges in the United States." *Journal of the Association of American Medical Colleges*, Vol. 13, pp. 196 ff., May, 1938.

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applications succeeded in securing acceptances. Nothing can better illustrate the formidable task with which admissions officers in medical colleges are confronted. The table presented here furnishes the setting for the movement to introduce some commonly acceptable criterion for the selection of suitable candidates from the vast army of applicants. To this should be added the evidences of mortality which show that about 15 per cent of the students drop out on account of poor scholarship or for other reasons by the end of the first year and that from 20 to 25 per cent fail to graduate. The problem then is how to select one out of every two applicants or one from every five applications showing the best promise of success.

In 1927 a study of the freshman class in the School of Medicine of George Washington University was begun by Dr. F. A. Moss, and was continued through 1928-29 with a view to devising a test which would indicate ability to pursue a medical course successfully and which could be used as a criterion, in addition to any other criteria that might be desired by each institution, for the selection of students for admission. The results of the first test on freshmen who had already been admitted were reported in 1929 by Dr. David Robertson, at that time Associate Director of the American Council on Education, before the Annual Congress on Medical Education, Medical Licensure, and Hospitals. The Council agreed to furnish the scholastic aptitude test for admission to medical colleges, without charge, to demonstrate

its value. Tests were administered to freshmen in fourteen medical colleges in April or May, 1929; the scores were sent to the deans of the cooperating colleges for the purpose of comparison with the grades of first year students. The grades were in turn sent back to the Council in order that the efficiency of the test for predicting grades might be studied. In the fall of 1929 the test was given to applicants or the entering class in fourteen institutions. In a report on "Scholastic Aptitude Tests for Medical Students," Dr. F. A. Moss presented the results of the first experiments before the Fortieth Annual Meeting of the Association of American Medical Colleges, held in New York City in November, 1929.⁴

In order to compare the test scores with first year grades the freshmen were divided into ten groups according to their scores on the test. In the highest tenth of the test scores 10 per cent made a grade of 90 or over, 83 per cent between 80 and 89, 7 per cent between 75 and 79, and there were no failures. In the lowest tenth none made a grade above 90, and only a very small percentage over 80. The number of failures was increasingly larger as one went down the aptitude scale. The average grades decreased steadily from the highest to the low score groups, so that in some of the lower groups even the highest quarter of the grades was practically all below the lowest quarter of grades for some of the highest score groups. Divided into four groups, of the students in the highest quarter on the test scores (181+) 8 per cent made a grade of 90 or over and 1 per cent

⁴ *Ibid.*, Vol. 5, pp. 90 ff., March, 1930.

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failed; in the third quarter 3 per cent made 90 or over and 6 per cent failed; in the second quarter only one student made 90 or over and 6 per cent failed; while in the lowest quarter no student made over 90 and 31 per cent failed. Out of a total group of about 900 students only one student in the lower half of the test scores made an average of 90 or more.

The correlations between test scores and final grades were unusually high—.59 for the group as a whole, and .72 in two schools; in only two schools was the correlation below .45. The number of semester hours of pre-medical credit, omitting those institutions in which all students were required to present 120 hours or a degree, had little predictive value. The correlation of the average of premedical grades with freshman grades was .50. If, on the scholastic aptitude test, admission were arbitrarily refused to the lower 40 per cent (below a score of 144), 75 per cent of the failures would be eliminated and only 12 per cent of those making a grade of 85 or above. The relative measure of efficiency of three measures in predicting failure was shown to be 22 per cent for entrance credits, 48 per cent for premedical grades, and 63 per cent for the scholastic aptitude test. The efficiency rating of a combination of these measures would be 74 per cent. The personal interview was not included in this study but was to be the subject of later experimentation. The investigation further revealed the variability of standards between different medical schools: in some schools the lowest 25 per cent of the students were above the highest 25 per cent in others; some schools were admit-

ting students with much greater aptitude than others—in one school 50 per cent of the scores were 194 and above, in another 50 per cent were below 93.

The conclusion of this experimental period was that the scholastic aptitude test could be of considerable assistance in the selection of students. It was proposed, however, that this should be an additional criterion and should not replace current methods. It was recognized that the test should be given on the same day in all medical schools of the Association of American Medical Colleges, that they should be scored and tabulated in a central office, and that reports should be sent to the deans, showing a comparison of each school with the total tabulation. In 1930 it was decided by the Association to charge candidates \$1 for the test; the fee was subsequently raised to \$5 in 1937.

After hearing the report, the Association recorded its sense of the importance of the study of aptitude tests in relation to the acceptance of students for medical schools as illustrated by the studies and data submitted by Dr. Moss, and appointed "a committee to direct an experimental study of aptitude tests for admission to medical schools along these lines." The development and use of the scholastic aptitude test have proceeded continuously since that date. In 1928-29 the number of students tested was about 1,000 in fourteen medical schools; in 1936-37 the number of students tested before admission had risen to 10,853, distributed in 627 premedical institutions, and the number of applicants admitted with the aid of the test had increased to 84 per cent.

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The Medical Aptitude Test is administered from the Washington office by Dr. F. A. Moss and his staff under the supervision of a Committee of the Association of American Medical Colleges. A new form of test is constructed each year with revisions of parts of the test and of items within each part as experience indicates to be necessary. In 1931 the test consisted of six parts, as follows: (1) scientific vocabulary; (2) visual memory for anatomical drawings; (3) memory for descriptive material; (4) premedical information; (5) learning and retention of material; (6) understanding of difficult printed material. In the form adopted for use in December, 1932, the test on premedical information was dropped, since a candidate's rating in this field was already included in the grades received in his premedical course, and two other tests were added. The form then consisted of seven parts: (1) scientific vocabulary; (2) comprehension and retention; (3) visual memory; (4) logical reasoning; (5) memory for content; (6) ability to follow directions; and (7) understanding of printed material. Further changes were made in subsequent years and in 1936 Form 9 consisted of five parts: (1) general information; (2) vocabulary; (3) spelling; (4) logical reasoning; and (5) understanding of printed material. Decisions to adopt changes in the forms of the test are based on a careful analysis and evaluation of previous forms. New tests are tried out with a group of known ability to determine their validity and reliability, and are scored, checked, and modified as the results demand after they have been submitted to the Committee on

Aptitude Tests for Medical Students for revision and suggestions.

These procedures mean intensive work for a staff working through each summer, and cooperation of designated representatives in some 700 premedical colleges where prospective students take the test. All tests that are sent out must be carefully accounted for, whether used or not. The scoring and tabulating of the tests must be done in less than two months following the date of examination, early in December of each year, in order that results may be uniformly available to the medical colleges by February 1. Since the purpose of the test is to furnish information to the authorities in each medical school concerned with the admission of students, careful reports must be prepared which will enable them to interpret the results not only for each student but for the whole group of students applying to each school so that comparative standards can be established both for the student body and for the schools. Accordingly, after the scoring and tabulation have been completed, reports are submitted to the deans of medical schools, presenting (1) a brief analysis of the separate parts of the tests and the particular mental process tested by each part; and (2) tables for interpreting the test results. From the tabulations percentiles are given on the total score and the deciles for each student on each part of the test. Certain corrections have to be made in the case of some candidates who have already taken the tests, and of others who have not completed the second year of the premedical course at the time of taking the test.

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The most important part of the procedure, however, is to discover the value of the test as a measure for predicting the success of students admitted to the study of medicine. This means a system which follows each student through each year of his medical course to graduation and into the year of internship, and involves the study of correlations between test scores and medical school grades and a system of rating students during their internship. Beyond this the relative predictive values of other criteria for admitting students to medical schools must be considered as well as reasons for failure or withdrawal during the course. All these tasks have been undertaken by the Committee and, as the use of the aptitude test has increased year by year until groups of students have been followed up through graduation and internship, it has been possible to reach certain standards of prediction so far as the test itself is concerned, although other reasons than aptitude and scholarship are recognized as playing an important part in withdrawals.

First, however, arises the question whether the test is a genuine test of medical aptitude or merely another form of test of general intelligence. In 1937 a study of this question was undertaken by instituting a comparison between first-year medical students and students in other professional institutions in their performance on the Medical Aptitude Test. It was found that students in schools of education, commerce, law, engineering, and the Postgraduate School of the Naval Academy made distinctly lower scores than medical students. Not more

than 11 per cent of any group did as well as the upper 50 per cent of the medical students, and less than 2 per cent of other professional groups equaled the upper 25 per cent of the medical students, while the lower quarter of the medical students made higher scores than the upper quarter of the non-medical professional groups. The test results did not predict success nearly as well in any other field as they did in medicine; the correlation between the test scores and grades of engineering students was .11, of law students .47, of commerce students .28, of naval officers .29, and of medical students .60. The conclusion reached was that the test was a better measure for predicting the success of medical students than of students in other professional fields and was to some extent a measure of aptitude for the study of medicine and not merely of general ability.⁵

The important question which those responsible for the test had to answer was whether it had a predictive value of success in medical studies. The results of the earliest and experimental stage of the test which led the Association of American Medical Colleges to adopt its resolutions to continue and extend its use have already been given above. Those results have been substantiated year by year. Thus in 1935, when 82 per cent of the applicants had been tested, it was found that of those who stood in the highest tenth on the test scores 60 per cent were admitted to medical schools; of those in the highest

⁵ *Journal of the Association of American Medical Colleges*, Vol. 13, pp. 177 ff., May, 1938. It should be noted, however, that one of the earlier forms of the test, which contained specifically premedical content, was used on this occasion.

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quarter 52 per cent were admitted; of those in the median half 40 per cent were admitted; while only 27 per cent of those in the lowest quarter and 19 per cent of those in the lowest tenth had been successful in securing admission. The test scores predicted success in the first year of the medical course and the average grades secured declined from the highest tenth on the test scores to the lowest tenth, with a corresponding increase in the percentage of failures as the test scores decreased.

In the highest tenth of the test scores in 1935 more than 50 per cent averaged a grade of 85 in the first year, with 12 per cent making averages of 90 or more. In the lower half of the test scores less than one per cent made an average grade as high as 90 and in the lowest three-tenths of the test scores none received an average grade of 90. In the lowest tenth 30 per cent failed and 26 per cent made average grades of 80, so that more than half the group failed or barely passed, while in the highest tenth only 16 per cent averaged below a grade of 80 and more than 50 per cent made averages of 85 or above.

A comparison of 541 students who had taken the test and had been admitted and 181 students admitted without taking the test showed that 29 per cent of the former made an average grade above 85 as compared with 21 per cent of the latter, and 19 per cent of the latter failed as against 12 per cent of the former. Of the first group 8 per cent withdrew; of the second, 14 per cent. The conclusion was that students admitted without taking the tests, so far as this study of students in ten medical

M E D I C I N E

schools indicates, are more likely to fail or withdraw and are less likely to do outstanding work than those who are admitted after taking the test.

A further study, reported in 1938, showed that students who made high scores on the test are admitted to medical schools in a decidedly larger proportion than those making low scores. The predictive value of success in the first year had been established and there was a decrease in the number of failures due to improvement with the test in initial selection. Dividing the students into decile groups on the test scores, 1 being the highest decile and 10 the lowest, the following results were shown :

Decile	Per Cent of Failures	Average Grade
1	2%	85
2	8	82.4
3	8	81.9
4	10	81.1
5	10	80.8
6	12	80.3
7	14	79.8
8	18	78.5
9	19	77.8
10	25	76.4

One of the difficulties encountered in administering the test is to secure a body of proctors who will follow the same procedure in such matters as vigilance and observance of time limits when the test is given in so many centers. Another difficulty arises from the fact that the test is not—perhaps ought not to be—the sole cri-

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terion of admission, with the result that able students according to the test scores are often excluded, but in smaller proportions than those in the lower score groups. At the same time there is also great variability in standards of admission in different institutions. Unfortunately information on this aspect of the problem has only been made available for the earlier years and has not been continued. Thus, the average percentile of students admitted in 1932 varied from 85 to 26 in different schools, and the percentage of students admitted with percentile ratings below 25—the lowest quarter tested—varied from none to about 50 per cent. The result of this variability is shown in the fact that one group of schools which admitted students with test scores above 180—the 70th percentile—showed only 1.5 per cent of failures, while another group admitting students with average test scores below 145—the 40th percentile—showed 9.9 per cent of failures.

As students who had taken the test passed through each year of the course it was possible to study further the value of the test as a measure of predicting success. A study of students who had taken the test and secured admission to medical schools showed that after two years the average grade of the highest tenth was 85.9 and of the lowest tenth 75.1; the lowest tenth produced 42 per cent of failures in the first year and 14 per cent in the second—a percentage of failures which if continued would mean that none in this group would survive to graduation. The correlation between test scores and average grades was .59 for the group in the fresh-

man year and .54 in the sophomore year, with some medical schools showing a correlation as high as .72 and .73 for each year, respectively. The same group at the end of three years in medical schools showed no failures and an average grade of 87 in the highest tenth, with 10 per cent securing a grade of 90 or over; for the lowest tenth the average grade was 75.2, just barely passing, while 60 per cent had failed somewhere along the line, none had secured a grade of 90, and only 1 per cent as high as 85. The failures tended to decrease and the average grade to rise year by year. At the end of the fourth year this group had shown no failures in the highest tenth and an average grade of 86, with 11 per cent obtaining a grade of 90 or more; in the lowest tenth 60 per cent had failed and the final average grade was 75 or barely passing.

A study of another class, graduating in 1933, showed approximately the same results—an average grade of 86 and no failures in the highest tenth of the class, and many failures and an average grade of 71.4 in the lowest tenth. Of 249 graduates from medical schools in New York State 2 per cent of the highest two-fifths on the test scores had an average grade of 90 or over, 39 per cent from 85 to 89, 47 per cent from 80 to 84, and 12 per cent from 75 to 79; of the lowest two-fifths on the test scores 6 per cent had grades from 85 to 89, 64 per cent from 80 to 84, 27 per cent from 75 to 79, and 3 per cent failed. In the examination conducted by the National Board of Medical Examiners 76 per cent of those taking the examination were in the upper half of the

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test scores and only 1.5 per cent in the lowest tenth. In 1932 on this examination, of the upper half on the test scores 6 per cent obtained a grade of 90 or more, 11 per cent 85 to 89, 61 per cent 80 to 84, and 22 per cent 75 to 79; of those in the lower half on the test scores 17 per cent received a grade of 85 to 89, 39 per cent 80 to 84, 33 per cent 75 to 79, and 11 per cent failed. In 1933 the results showed in the upper group 2 per cent with 90 or over, 23 per cent 85 to 89, 46 per cent 80 to 84, 24 per cent 75 to 79, and 5 per cent failed; in the lower group only 1 per cent reached a grade of 90 or over, 14 per cent secured from 85 to 89, 33 per cent 80 to 84, 40 per cent 75 to 79, and 12 per cent failed.

Carried to a still further stage it was possible to show the predictive value of the aptitude test for students in their year of internship, that is, five years after taking the test. The study was concerned with graduates of the class of 1932 who were distributed as interns in forty-eight hospitals which took three or more students on their staffs. A rating scale for interns was set up, ranging from 1 to 5, as follows: 1—comes up to the best intern the hospital has had; 2—is good, above average but not equal to the best intern the hospital has had; 3—is equal to the average intern the hospital has had; 4—is below the average intern but better than the poorest the hospital has had; and 5—is among the poorest the hospital has had. The results of this study revealed these facts: The highest tenth (with a score above 200) on the aptitude test received an average rating of 1.8 as intern, with 41 per cent rated 1 and none rated 4 or 5.

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The group above the median (with a score from 150 to 199) showed an average rating of 2.2, with 25 per cent rated 1 and 7 per cent rated 4 or 5. The group below the median (with a score from 100 to 149) were rated 2.4 on the average, with 16 per cent rated 1 and 8 per cent rated 4 or 5. Those in the lowest tenth (with a score below 100) had an average rating of 3.2, with only 10 per cent rated 1 and 37 per cent rated 4 or 5. Allowances must, of course, be made in this study for the somewhat subjective nature of the ratings and the fact that a large percentage of the lower scores were already eliminated during the preceding four years of the course. Nevertheless the figures do have some comparability.

By 1935 it was possible for the Chairman of the Committee on Aptitude Tests for Medical Students, Dr. T. Sollman, to say that "you could practically superimpose statistics for four years year after year with exactly the same curve." In the same year, at the Forty-sixth Annual Meeting of the Association of American Medical Colleges, held in Toronto, there was presented a "Report of the Special Committee on the Evaluation of the Aptitude Test for Medical Students." The Evaluation included the reports of three psychologists on the test itself. Dr. F. L. Wells of the Psychological Laboratory, Boston, stated that the test "functions (1) as an intelligence or mental alertness test, and (2) somewhat to favor persons whose development has led them to take an interest in medical topics." Dr. R. A. Brotemarkle, College Personnel Officer, University of Pennsylvania, wrote: "I

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feel that on the whole the test is very good, that it would be a needless task to begin from the ground up in reconstructing another test, and that the need is for continued study and improvement of the present test forms. . . . Whatever benefit may accrue from the use of the Medical Aptitude Test must be found in conjunction with the student's grades, his recommendations, and such personal analysis as may be made by interview, correspondence or recommendation." Professor E. L. Thorndike, after reviewing the examinations, thought that they were very good; they might be made longer by the addition of a more generalized test in the comprehension of what one reads. The tests in his opinion serve better to predict success in the first two years of medical school than success later and throughout life. "I imagine," he wrote, "they are frankly designed to weed out the kind of person who would be weeded out by the first two years of work in medical school."

The final question is that of the value of the test compared with other criteria. The report presented before the Annual Congress in 1930 showed that the percentage of failures predicted by semester hours of premedical credits was 22 per cent, by interview ratings 33 per cent, by premedical grades 43 per cent, and by test scores 69 per cent, by a combination of premedical grades, interview ratings, and test scores 67 per cent, and by a combination of premedical grades and test scores 73 per cent. The report presented in 1932 showed that age at entrance, which is negatively correlated with course marks, predicted 28 per cent failures, entrance

credits (70 or more semester hours) 58 per cent, pre-medical grades 45 per cent, test scores 55 per cent, and a combination 69 per cent. Everything seemed to point in favor of the use of a combination of criteria, relative weight being given to each and critical points to be established at the discretion of each medical school. It was suggested that the most convenient system would be to give a definite numerical consideration to the pre-medical grades and the test, while using personality ratings, interviews, and recommendations as a final check without giving them a definite numerical evaluation. It must be noted, however, that premedical grades, particularly when presented by students drawn from a large number of premedical institutions, are themselves very variable on the one hand and do not differentiate students adequately. The aptitude test has at least the merit of being uniform in standard and providing results that are comparable. Since all the entrance criteria here considered are positively correlated, the aptitude test may be used as a mediating device to make the other criteria more comparable.

Experience with the tests appears to have established as facts which can now be accepted the chances that students who rank in the highest tenth on the test scores will certainly pass in the work of the first two years and that 93 per cent will secure an average grade of over 80. If, however, they fall into the lowest tenth, their chances of passing in the work of the first two years are reduced to 50 per cent, while only 25 per cent of the group are likely to obtain an average grade of 80. Looking beyond

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the first two years all in the highest tenth on the test scores will graduate with a 5 to 1 chance of securing an average grade of 85 or more and 1 chance in 10 of an average grade of 90 or over. By contrast the chances for a student who falls in the lowest tenth on the test scores are 6 to 1 that he will not graduate, 9 to 1 that he will secure an average grade below 85, and 2 to 1 that he will have an average grade below 80 if he does graduate, with no likelihood of obtaining an average grade of 90.

The number of applicants for admission to medical schools who take the aptitude test has increased to about 85 per cent. A few institutions, like the College of Physicians and Surgeons, do not require the presentation of test results as part of the entrance requirements but may use them as a check, if presented by an applicant. So far as published literature is concerned only one institution, the Medical School of the University of Minnesota, has found the Moss Medical Aptitude Test inapplicable to its own local situation, where it has proved quite ineffective as a basis for predicting probable success. A statistical combination of the Moss test scores and average pre-medical grades did not yield a measure significantly more effective than the premedical grades alone. Accordingly, a local aptitude test was constructed which would duplicate in miniature the basic types of tasks and problems set in the first year of medical studies at the University of Minnesota. Efforts were restricted to work of the first year, where the greatest number of failures occur.

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Three batteries of tests were assembled and given in 1935-36. They include the following types of tests: (1) comprehension and retention of reading material; (2) ability to classify reading material in outline form; (3) ability to recognize relevancy of facts to problematic situations; (4) ability to recognize inconsistencies in statements; (5) ability to solve non-numerical problems in science; (6) science survey tests calculated to sample the knowledge of facts in various fields of high school and college courses in science, particularly biological science; (7) ability to classify terms; (8) ability to recognize and classify characteristics common to a series of objects; (9) ability to judge spatial relations to spatial imagery. Because of their low correlations the first two of these tests were dropped.

The Minnesota Medical Aptitude Test was given in January, 1935, to 95 students, excluding members of the class who did not take the final comprehensive examinations. The correlations of the Moss Aptitude Test with average grades in the first two years was .17 and with the grades in the sophomore year .16; of the Minnesota Test .33 and .29, respectively; of the premedical honor point ratio .53 and .52, respectively. The general conclusion is that the Minnesota Medical Aptitude Test, when used alone, does not furnish an accurate prediction of scholastic success in the medical school; this claim has, of course, not been made for the Moss Medical Aptitude Test. Further, the Minnesota Test was used with a homogeneous group of students already selected for admission, a very important factor. The value of aptitude tests,

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according to the group in charge of the investigation, is likely to be in helping to improve prediction by other means rather than in their use without other criteria. By combining premedical grades with the scores on the Minnesota Medical Aptitude Test, as a measure for predicting success in the University of Minnesota Medical School, the predictive validity is increased to between .57 and .61, as indicated by a coefficient of correlation. At present applicants for admission to the University of Minnesota Medical School are submitted to a battery of tests, including the sophomore general culture test of the Cooperative Test Service, the Strong Vocational Interest Test, the Minnesota Medical Aptitude Test, and the Moss Medical Aptitude Test.⁶

Nevertheless, the results to which the Moss Aptitude Test seem to point have been confirmed from another direction. Since 1932 Dr. F. C. Zapffe, Secretary of the Association of American Medical Colleges, has reported annually on the "Accomplishment of the Freshman Classes" in the medical schools of the country. These reports furnish records of the numbers of applicants and applications, the number of applicants accepted, the length of premedical courses taken, and the records of the freshmen through their first year. On the basis of reports from the medical schools there are presented each year tables of the percentages of students whose records are clear or encumbered or who have been eliminated

⁶ It would be very desirable to indicate the homogeneity of Minnesota students, so that the correlations could be compared with those of Moss. The Minnesota Test, if given in colleges in which the Moss Test gets correlations of .60, might yield correlations of .70 or .75.

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for poor scholarship or have withdrawn. In general, about 14 per cent of students fail in the first year and 25 per cent in all fail to graduate. The report on "The Accomplishment of the 1935 Freshman Class in 78 Medical Colleges" presented a correlation of aptitude test rating with accomplishment; of 6,552 students 71.8 per cent had taken the test. Accomplishment is indicated in four categories—clear, encumbered, out, or withdrawn. The comparison is given in the following table:

Test Rating	Clear	Encumbered	Out	With- drawn
1-33	643	203	198	46
34-66	1,027	202	157	46
67-99	1,608	165	102	44
Total	3,278	570	457	136
	75.8%	12.9%	10.5%	3%

A similar comparison for the Freshman Class of 1936 produced the following results:

Test Rating	Clear			Encumbered	Out	With- drawn
	Upper	Middle	Lower Third			
1-33	17.9%	27.6%	14.6%	22.2%	13.3%	4.3%
	60.2%					
34-66	26.6	31.6	15.6	16.1	6.7	3.3
	73.9					
67-99	40.0	28.6	14.3	11.2	3.9	1.8
	83.0					

It will be noted in both tables that it is the lower third of the class which causes trouble. If greater discrimina-

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tion were shown in admitting students in this group, the mortality of the class as a whole would be lessened and only 10 per cent of the group which might get into the upper third in medical school would be eliminated. Of the repeaters 41.5 per cent were in the lower percentile group, 36.9 per cent in the middle, and 21.6 per cent in the upper percentile group. That the standing of students who continue through the medical course improves is indicated in the following table:

Accomplishment of Sophomores, Juniors and Seniors, 1936-37
(22,212 Students)

	Clear	Encumbered	Out	Withdrawn
Sophomores	77.4%	16.0%	5.1%	1.5%
Juniors	81.3	16.9	1.3	0.5
Seniors	96.0	2.2	1.3	0.5

The table means that the weakest students have been eliminated before reaching the senior year. At the same time a few, but a far smaller number, continue to the very end.

With the availability of so much information about medical students in the offices of the Committee on the Medical Aptitude Test and the Association of American Medical Colleges, excellent opportunities exist for perfecting the control of admissions and determining methods of selection of prospective medical students. It will always remain true that in a profession which demands such close relationships as exist between the doctor and his patients, other factors enter into the problem of selec-

tion than scholastic ability and aptitude. Up to the present it has been established that more failures are due in the main to poor scholarship than to withdrawals for personal reasons on the part of students.

The continued studies of Dr. Moss and Dr. Zapffe still leave a few questions unanswered. Despite the widespread use of the Medical Aptitude Test there remains a considerable variability in standards of admission. Some of the medical colleges continue to admit students from the lower groups on the percentile ratings. A study of the distribution of failures by separate institutions has not been published, although confidential information on this aspect of the problem is certainly available to the Committee.

To the variability in standards of admission there must also be added variability in standards of marking in each medical school. In other words, for admission purposes students are rated on a test which is checked for reliability, accuracy, and validity, and these ratings are then correlated with marks which in the majority of cases are arrived at by another type of examination. It may be, of course, that variability of marking in the medical schools does not seriously affect the problem, but it is a question which deserves further consideration. From Dr. Zapffe's studies on the accomplishment of students there is a suggestive contribution in the fact that students admitted with A. B degrees do better work on the whole than students who have not graduated or who have graduated with other degrees; students admitted with only two years of premedical studies come

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second to students with the A. B. degree. Dr. Zapffe's conclusion appears to be that a good general education is a better guarantee of success in medical school than an education in which the sciences predominate.

Finally, in view of the fact that the number of applicants has shown a steady increase in the last ten years and since the number admitted appears to fluctuate from year to year, the time seems to have arrived for a study of the relation between supply and demand and an adjustment between the two in place of a system which appears to be on the surface haphazard and empirical. Certainly this problem will have to be considered seriously if the time ever comes when a system of socialized medicine is adopted, whether on a state or a national basis. None of the studies yet made either by the central office of the Association of American Medical Colleges or by the Committee on the Medical Aptitude Test has yet considered the question of the adequate distribution of medical practitioners and of medical service. Great strides have, however, been made in the advancement of the controls of methods of selection to meet the situation as it exists at present.

Law

THE NEED OF SOME METHODS of selective admission to the study of law has arisen, as in the case of admission to other institutions for professional study, from the increasing number of applicants, the persistence of a high percentage of failures, and the desire to prevent overcrowding in the profession. The assumption that there is overcrowding in the legal profession is, however, nothing more than an assumption which has not been established with reference to the needs of the country as a whole. If it has any basis at all, it is in the further assumption that the failure of a number of lawyers to maintain the ethical standards of legal practices can be prevented by setting up barriers to admission to study for the profession. So far, at any rate, the profession has failed to take into account the fact that candidates for admission must overcome two hurdles—when they apply for admission to law schools and to the bar—and that in both cases evidence of good character must be produced. In other words, from the point of view of maintaining ethical standards the profession has not given adequate attention to the causes of malpractices which may be

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found to lie within the profession itself rather than in defects of character of the percentage of practitioners who fall below the standards. The problem from this aspect may be, and probably is, more one of social and economic distribution of lawyers and of the administration of law than of education and preparation. It is impossible, in other words, to assume that there is overcrowding in a profession and to proceed to set up barriers to admission at the initial stages of training without a thorough effort to investigate from the social point of view and the interests of the public what the nature and causes of such overcrowding are.

That institutions of education and professional preparation have a definite responsibility for the ethical character of their students is beyond dispute. They have an equal responsibility for the educational standards which they maintain. This responsibility means that in the interests of the individual and of society and in the interests of their own effectiveness standards of admission should as far as possible aim to reduce the incidence of failure. A high percentage of failures can no longer be accepted as a measure of a high standard of institutional success. Schools of law, like schools of medicine, have for many years been disturbed by the number of students who fail, and began generally about 1925 to consider measures to improve the selection of students. Unlike schools of medicine, schools of law have not developed standards for self-regulation and standardization which in the case of the former have the strong support of their professional association. Schools of medicine again can

base their case for limiting the number of prospective candidates on accommodation and clinical facilities, although, as pointed out earlier, this argument fails to take social needs into account. Schools of law, on the other hand, cannot on the whole rest their case on such an argument, partly because it is assumed that the size of classes is unimportant, and partly because they are still unstandardized and the student has a choice between approved and unapproved schools.

Nevertheless, a number of approved institutions have been concerned not only about numbers but about quality, and, while accepting the minimum standard of two years of college studies for admission, have sought to go beyond this in terms both of length of previous study and of intellectual capacity. In this search tests of capacity to study law have been developed, but as contrasted with medical education where an aptitude test has been constructed, administered, and scored by a central committee, the development and progress of the legal aptitude test have been casual and sporadic, without that continuity of use and experimentation which would yield satisfactory results. There seems to have been a sudden burst of interest about 1925 in the possibility of employing a legal aptitude test, but the interest died down in about ten years. Only two leading schools of law have continued to employ tests of capacity, while the small number which had tried them in the early years of this decade have discarded them, generally in favor of college records.

The raising of the minimum requirement for admis-

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sion to an approved law school to two years of college provided no assurance of success in legal studies. Mortality continued to be high and could not be accounted for by the lack of general intelligence; students with good college records were also found among the failures in law schools. The conclusion was reached about 1925 that success in law schools required specific intellectual capacities. To discover these it was necessary to work back from the capacities which a lawyer requires for his work. In general these include power of analysis, recognition of the crucial point in a mass of facts, ability to memorize quickly, and ability to assimilate what has been learned. To these must be added alertness, verbal facility, and the possession of a large vocabulary.¹

The first law aptitude examination designed to test such capacities was constructed by G. D. Stoddard and M. L. Ferson, the one a psychologist, the other a lawyer. The test, already tried out in 1925 at the University of North Carolina by Dean Ferson, included the following sub-tests for which the perfect scores are given in parentheses: (1) capacity for accurate recall (15); (2) reading comprehension (30); (3) reasoning by analogy (50); (4) reasoning by analysis (30); (5) skill in pure logic (20).² All the sub-tests except that in logic were based on legal materials. The composite scores of 457 students in eight universities (Drake, Illinois, Iowa,

¹ See Bingham, W. V., *Aptitudes and Aptitude Testing*, pp. 178 ff. New York, 1937.

² The Ferson-Stoddard Test was published by the West Publishing Company; the second and third editions appeared in 1926 and 1927.

Kentucky, North Carolina, Northwestern, Southwestern, and Wyoming) were published in 1927, and showed the following results: ³

	Parts				
	1	2	3	4	5
Upper quarter	10.7	14.1	39.6	26.8	14.1
Median	9.1	9.4	33.2	22.8	9.4
Lower quarter	7.2	6.4	26.9	20.6	6.4

Every part of the test was found to be positively correlated with the first year and semester grades in law, whether taken in the aggregate or by separate courses. The correlation between the whole test and first semester grades for 136 only of all the students tested was .547; between the whole test and first year grades, .539. The relation between first semester grades and test scores is shown in the following table:

	Grades				
	A	B	C	D	F
Highest quarter	15%	37%	35%	9%	4%
Second quarter	18	28	35	13	6
Third quarter	0	15	52	19	14
Lowest quarter	0	9	34	28	29

The test was successful to the extent that it could indicate a sharp demarcation between the upper and lower halves of those tested, and, while not revealing a marked difference between the highest and second quarters, did show a distinct superiority of the third over the fourth quarter.

³ See Stoddard, G. D., "The Ferson and Stoddard Law Aptitude Examination. Preliminary Report." *American Law School Review*, Vol. 6, pp. 78 ff., 1927.

The appearance of the test attracted the attention of Dean John H. Wigmore, who was interested in some device for "the saving of misguided effort through dependable advice." In an editorial on "Juristic Psychopoyemetry—or How to Find Out Whether a Boy Has the Makings of a Lawyer,"⁴ Dean Wigmore discussed the results of his own experiment with the Ferson-Stoddard Test with 50 students of his entering class who volunteered for the test. For his purpose, that is, to predict the high capacity of a particular individual for law studies, Dean Wigmore did not find the test particularly valuable. He concluded that for two classes in which he had tried it this law aptitude test showed no usable predictability and that while it might be used for predicting those who would come out at the bottom of the class, it was not suited to predict those at the top. What Dean Wigmore was looking for was individual predictability—"some test that will enable me to say with fair certainty that he will not make a good lawyer."

Professor A. B. Crawford took up the cudgels in favor of the Ferson-Stoddard Test, while admitting that the correlations cited by Professor Stoddard were based on only 136 cases. Pointing out that no perfect test of prediction had yet been devised, he said the basic question is not whether a given procedure can give a perfect result but whether it can show a *better* result than any other available measure. The test may not identify *all* the best students but it is a device which, *ceteris paribus*,

⁴ *Illinois Law Review*, Vol. 24, pp. 454 ff., 1929-30. Psychopoyemetry is a word coined by Dean Wigmore for "the science of measuring capacity for mental achievement."

could be used to reject applicants who make low scores. As stated by Professor Stoddard all that a test can be expected to do is to assign to each student of known accomplishment a figure representing the probability of success for that category of students in which he is reliably placed.⁵ These statements were corroborated by Professor H. B. Witham, who claimed that the Ferson-Stoddard Test, which had been used for three years at the College of Law of the University of Tennessee, had a substantial value in discovering whether a student had ability to grasp mentally the elements for success in law, but not necessarily all the elements that make for success. The test predicted the poor students better than the able and, while it possessed no immediate usable predictability, gave a good indication of the probable success of a law student.⁶

This was borne out in a report of the results of the test at the New Jersey Law School, where in 1928 the students of the freshman and junior years took the test. The distribution of the raw scores of both classes showed that the medians and quartiles for the juniors were higher in each case than those for the freshmen, owing to the fact that 18.6 per cent of the class then in the junior year had been eliminated at the end of the first year. A distribution of the students entering in 1928 into fifths showed a steady decline in the number who

⁵ It will be recalled that this is all that is claimed for the Medical Aptitude Test.

⁶ For the discussions of Dean Wigmore's article see *Illinois Law Review*, Vol. 24, pp. 680 ff., 801 ff., 1929-30; and Vol. 25, pp. 446 ff., 1930-31.

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succeeded in passing the work of the year according to their place in this distribution. The percentage of successes, failures, and discontinuances of the 1928 freshmen in each fifth of the scores on the aptitude test is shown in the following table :

	Succeeded	Failed	Discontinued
First fifth	82.4%	15.4%	1.8%
Second fifth	73.5	20.7	5.4
Third fifth	65.1	27.1	7.4
Fourth fifth	57.3	32.3	10.5
Fifth fifth	58.8	42.0	19.2

When the lowest fifth was divided into two halves the following results were shown :

	Succeeded	Failed	Discontinued
Upper half	50.0%	35.7%	14.3%
Lower half	27.6	48.3	24.1

The corresponding picture for the junior class of 1928, when 18.6 per cent of the class had already been eliminated, differs as follows :

	Succeeded	Failed
First fifth	95.2%	4.8%
Second fifth	85.0	15.0
Third fifth	54.5	45.5
Fourth fifth	69.6	30.4
Fifth fifth	65.0	35.0
Upper half	75.0	25.0
Lower half	58.5	41.5

The authors of the report conclude that the test has great value in giving the instructors an idea of the

abilities of the group, in helping to advise students, and in pointing out cases which need special attention. Beyond this, however, no single method of gauging a student's ability ought to be relied upon for purposes of admission. A combination of methods—college grades, tests, and other measures, including moral, personal, and health data—is desirable.⁷

The same conclusion was reached by Professor W. L. Eagleton of the Law School of the University of Chicago after an experiment in which there were combined the applications of the Thurstone Test and the Ferson-Stoddard Law Aptitude Test. The tests were given to entering students in 1930 and were correlated with the first year law school averages. The coefficient of correlation between the whole Thurstone Test and the law school averages was $+.54$, and between the whole Ferson-Stoddard Test and the law school averages, $+.49$. The coefficient of correlation between the gross scores of all the nine parts of both tests and law school averages was $+.62$. The correlations between different parts of the tests and law school averages varied considerably; the reading comprehension sub-test of the Ferson-Stoddard Test gave better results than the whole test. The general conclusion was that the tests had a definite value for selection but had not reached the limit of validity; while they could be improved, they should be supplemented with other information about each applicant—college record, information furnished in the application, and

⁷ Gaudet, F. J., and Marryott, F. J., "Predictive Value of the Stoddard-Ferson Law Aptitude Examination," *American Law School Journal*, Vol. 7, pp. 27 ff., 1930.

impressions obtained by personal interviews.⁸ This conclusion was corroborated five years later by Professor Frank Murray of the College of Law, University of Kentucky. After discussing the value of college averages as a measure of predicting law school success Professor Murray stated that, while the reports on the use of tests show results to be a helpful basis for predicting the type of work that will be done by a student, the tests measure only some of the determining characteristics and fail to predict the presence of others. When considered as the sole test for admission they are probably no more accurate than college averages, with the disadvantage of removing a desirable emphasis on college work.⁹

Before considering the value of college averages as predictions of success in law school, which appears to have had considerable influence on the attitude toward the development and progress of aptitude tests, experience with the use of tests in two schools of law (Yale and Columbia) which has been continuous over a longer period than elsewhere will be discussed. The School of Law of Yale University adopted the practice of selective admissions, and about 1926 limited the number to be admitted each year to 100. In addition to the general requirements—college record, letters of recommendation from college instructors, and interviews—experiments were undertaken with aptitude tests. The first tests used

⁸ Eagleton, W. L., "Admission Requirements for the Law School and the Bar," *Illinois Law Review*, Vol. 27, pp. 27 ff., 1932-33. Also *The American Law School Review*, Vol. 7, pp. 521 ff., 1932.

⁹ Murray, F., "Requirements for Admission to Law Schools," *Kentucky Law Journal*, Vol. 26, pp. 290 ff., 1937-38.

were the Thorndike CAVD Test, which took four hours, and a test of twenty minutes constructed by Professor J. Crosby Chapman. The average correlation of the Thorndike Test was $+.45$, of the Chapman Test $+.40$, both lower than the correlation between college grades and first year grades in law school. Neither test, however, was a test of legal aptitude specifically. A new test was constructed by Professor A. B. Crawford of the Yale University Department of Personnel Study, based on the nature of the work with which law students are expected to deal: (1) highly verbalized material calling for precision in the use of language, clarity of expression, and skill in interpreting previous decisions; (2) analysis and accurate subdivision of complicated problems into component parts; (3) use of analogy; and (4) judgment of the applicability of certain principles. This test, on being tried out with various groups experimentally, yielded a raw coefficient of correlation with first year law school grades of $+.64$. Out of twenty-five students eligible to compete for the *Law Journal* after their first year, all but three stood in the upper half of the test scores and these three were at the top of the third quarter. All but one of those ineligible to return to law school, that is, with an average below 65, were in the lowest quarter. For 99 cases in the first year (class of 1933) for whom data were available, the correlation of the test and college grade weighted-combination with actual first year law school grades was $+.78$.

The Yale experience indicated, first, that a general intelligence test is unsatisfactory for purposes of admis-

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sion; second, that there might be "something definable in terms of what the law school expects its students to do; something to test the particular kind of thinking required for the work of the school"; and third, "that anything which we can get in the way of additional evidence which will increase predictability of success in law school above whatever previous measure of success has been attained is just that much velvet." So far as the test could indicate, the odds were ten to one against any student doing average work in the law school if his score fell in the lowest quarter, and about even that he would fail in the first year. Theoretically all but one of the failures might have been excluded in advance by setting the legal aptitude minimum at a given point, and only one student who did creditable work would have been excluded. While the test is by no means perfect, it does a considerably better job than any other criterion previously used. A combination of test scores and college average grades shows a more marked tendency for the student who is high on the one to be high on the other. Test scores alone correlated $+ .64$ with first year law school grades; the correlation between a combination of test scores and colleges grades is $+ .78$; both figures are higher than any other tests or combination of criteria. At the same time it was decided to use the test merely as evidence supplementary to other criteria. In the words of Dean C. E. Clark, formerly of Yale University School of Law: "As yet the aptitude grades are most useful as cumulative evidence; we are not now contemplating exclusive reliance upon them to determine our selection of

men." Elsewhere Dean Clark, in discussing the subject, stated that "We do not rely exclusively or largely on them [the test results], but they do afford valuable checks upon or confirm the other material." The number of failures has been reduced from about 20 per cent to 4 per cent, and it is possible to prophesy, if not the very individuals, at least the very groups from among whom the cases of failure or those on the border line will come. The present method, by stopping students at the source, avoids waste and ineffectiveness.¹⁰

The School of Law of Columbia University initiated its experiments with tests as far back as 1921, when Dean (now Justice) Harlan F. Stone wished to ascertain the causes of failures and to devise the best ways of preventing the admission of students who were not likely to do satisfactory work. Since it was thought that an important, though not the only, cause of failure in law school is inability to work effectively with abstractions and symbols, a test of this type of ability was developed in 1921 and tried over a period of four years; the ratings over three years were then compared with law school grades. The lowest score was 29, the highest 114; it was shown strikingly that over 90 per cent of those who obtained a score below 75 failed to do good work in

¹⁰ See Clark, C. E., "Admission and Exclusion of Law Students," in *Handbook of the Association of American Law Schools*, pp. 45 ff., 1931; "The Selective Process of Choosing Law Students and Lawyers," *The American Law School Review*, Vol. 7, pp. 913 ff., 1933; "Making Selective Admission to the Bar Practicable," *Ibid.*, Vol. 8, pp. 13 ff., 1934.

Crawford, A. B., "Use of Legal Aptitude Test in Admitting Applicants to Law School," *Bar Examiner*, Vol. 1, pp. 151 ff., 1932; "The Legal Aptitude Test Experiment at Yale," *The American Law School Review*, Vol. 7, pp. 530 ff., 1932.

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law school—three-fourths of them were dropped for deficient scholarship and all below 75 represented 61 per cent of all whose work was unsatisfactory. It did not follow, however, that while those below 75 would almost certainly do unsatisfactory work, a good score on the test was a guarantee of successful work. To deny admission to applicants who scored less than 75 would not prevent good candidates from entering but would reduce the number of failures by half; the causes of failure include other factors than deficient scholarship—outside activities, health, emotional disturbances, lack of interest, laziness, and so on—which may or may not be revealed by a college record or application blank or interview. “No one,” declared the Dean in his Report, “believes that it is possible to determine in advance all of the students who, if admitted, would do unsatisfactory work. Nevertheless the Faculty is convinced that by means of the capacity test, a careful study of the applicants’ college records and such other pertinent data as may be available, it is possible to determine in advance most of the men who would fail if admitted.”

In 1928 the Columbia University School of Law moved to limit admission to a carefully selected group of students who have the qualities of mind, character, and personality to meet higher standards and are drawn from all classes and sections of the country. This was accompanied at the same time by a plan to limit the numbers of students to meet the available accommodation and to maintain smaller classes. For several years one-third of the students were excluded at the end of the first year;

in 1928 out of 386 first year students 146 or 41.47 per cent failed to maintain an average grade to continue their studies, which meant the waste of a year. All had had three or four years of college work. The Faculty accordingly voted in 1928 that beginning with the academic year 1928-29 all applicants, who must have had at least three years of college, should be required to take a capacity test in addition to submitting college records and other pertinent data. Only those would be admitted who on all the data gave promise of doing thoroughly satisfactory work. A fall in registration was expected in the early years of the new requirements, with a subsequent rise in numbers and improvement in quality.

The Columbia University School of Law has now had ten years of experience with selective methods of admission adopted to predict potential failures, to eliminate the wasteful procedure of the trial and error method, and to weigh an applicant's general fitness for the legal profession, moral as well as intellectual. Under the present system candidates are admitted on the basis of their college average, the capacity test score, the recommendations of the dean and three professors of the college attended, their applications, and, wherever possible, a personal interview. The college record throws light on an applicant's industry, interest, and ability; the college averages are put on a comparable basis. Important though the college record and college average may be, they are not sufficiently trustworthy to be used as the sole basis of a selective process. The information furnished in the application is enlightening in so far as it gives the ap-

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plicant's reasons for wishing to study law and "gives some clue not only to his ability to express himself and to his intellectual powers but also to his moral and social outlook." The confidential opinions of deans and professors on an applicant's mental ability, common sense, character, industry, and personality, rated as "excellent," "good," "fair," or "poor," and combined with their opinions that an applicant is "decidedly," "doubtfully," or "not at all" worthy of admission, have been found to be valuable. Wherever possible, use has been made of personal interviews which are reported on standardized blanks. Finally, there is the capacity test calculated to test not general mental ability but a student's ability to work effectively with abstractions and symbols, a capacity necessary to do the kind of work required of law students. On the test as constructed by Professor E. L. Thorndike, it is next to impossible for a student not fitted for the study of law to obtain a high score. The passing mark for the test has been set at 75, with discretion given to the Selection Committee to admit applicants with test scores down to 65. Since 1936 the Committee has admitted without the capacity test those applicants whose college average on the Columbia equivalent is B or better; the number so exempted was 66 in 1936 and 86 in 1937. In a few cases exemption from the test began to be granted to applicants whose college average in other institutions was B or better.

In the Report of the Faculty Committee on the Selection of Students¹¹ the results of the new methods of ad-

¹¹ Included as an Appendix to the *Report of the Dean of the School of Law, Columbia University, for the Period Ending June 30, 1937.*

mission are given for the nine-year period 1928-29 to 1936-37. Of the 2,093 students included in the study 163 or 7.79 per cent obtained a first year law average of 1 to 1.75; 486 or 23.22 per cent an average of 1.751 to 2.5; 694 or 33.16 per cent an average of 2.501 to 3.25; and 502 or 23.98 per cent received an average below 3.25 and failed to meet the scholastic requirements for the first year; 248 or 11.85 per cent withdrew during the year or failed to complete examinations.¹²

The percentage of failures had fallen from 41.47 per cent in 1928-29 before to 23.98 per cent after the adoption of the selective process. Failure, however, is not always due to lack of capacity; illness, emotional disturbance, lack of interest, laziness, and personal problems may be contributory causes which cannot be anticipated. There is ample evidence that the danger zone in considering admissions is a college average of below B — and a score below 85 on the capacity test. Of 446 failures in Columbia University School of Law from 1928 to 1935, it was shown that 174 students with a B — college average failed and 146 with a capacity test score of 85 or below did not maintain the required average; only 57 students among the failures, on the other hand, had B — or better and 85 or above, showing that a combined college average and capacity test score is a more reliable basis for selection than either factor alone.

This is further corroborated by a study of each factor alone. Of 2,031 students for nine years, 1928-36,

¹² A to A — is approximately 1 to 1.75; B + to B, 1.751 to 2.5; B — to C, 2.501 to 3.25; below C —, 3.251 to 6.

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92 or 11.54 per cent of the 797 with a B or better college record failed, while 194 or 15.56 per cent of the 1,274 with a B — or better fell below the required average of 3.25. Of 784 students with a college average of C + or lower 290 or 37.83 per cent failed. A good record must not, however, be taken as a guarantee of success, since this study shows two failures with A records, six with A —, 30 with B +, and 54 with B; conversely a few students with records of C + (12), C (7), and C — (1) received a law school average of 1 to 1.75, but they had high capacity test scores. The coefficient of correlation between college average and first year law school achievement is +.407, which means that the value of the college record is better for predicting potential failures than for predicting probable success.

A corresponding study of 1,980 students on the capacity test alone bears out that the test is not a certain index of law school achievement, since 3 with a score of 105 +, 9 with 100 to 104, 24 with 95 to 99, and 47 with 90 to 94 failed in the first year; conversely 27 students with scores below 85 (only 2.67 per cent of 1,016 students in this group) secured a law school average of 1 to 1.75 and constituted 18.12 per cent of 149 students who made this average. While 162 or 16.80 per cent with a test score of 85 or above failed, 319 or 31.39 per cent of 1,016 students with scores below 85 did not maintain the required average. There is a steady increase in the percentage of failures as the capacity test scores decrease: 22.19 per cent from 85 to 89, 26.21 per cent from 80 to 84, 33.52 per cent from 75 to 79, and 37.99

per cent below 75 failed. Below 85 is the danger zone where the percentage of failures exceeds that for the entire group. A student with a score from 80 to 84 is a fair risk; one below 80 is a poor one, on the whole. Nevertheless the coefficient of correlation of the capacity test scores and first year law school achievement is only $+.375$, which is lower than the correlation between adjusted college average and first year law grades.

The two studies of college averages and capacity test scores indicate that they act as a valuable check on each other. For example, most of the students who maintained a high law school grade, though they were below 85 on the capacity test, had high college averages. On a combination of the two methods of selection of 612 students with college averages of at least B — and with test scores of 85 or above, 105 or 17.16 per cent maintained a law school average of 1 to 1.75 and only 56 or 9.15 per cent failed as compared with 22.67 per cent failures among students with B — and above and 16.8 per cent failures among students with a capacity test score of 85 or above.

In 1936 the Selection Committee was allowed discretion to waive the capacity test in the case of students with B or better. Exemptions were granted to 66 students; of these only 5 or 7.58 per cent failed. Of those admitted on the capacity test 44 or 34.28 per cent failed. The Committee concluded that for a student with a lower college average the capacity test is a necessary expedient. The practice of exemptions has accordingly been continued.

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An examination of the records (college average and capacity test scores) of 134 *Law Review* editors from 1928 to 1935 led to the conclusion that a slightly higher percentage have high college averages than high capacity test scores, but although on the whole they have had either a high college average or a high capacity test score, the combination of the two is not as indicative as the single items. The Committee was of the opinion that a high capacity test score is not necessarily indicative of distinguished law school success.

The experience of the Columbia University School of Law since 1927 appears to have borne out the expectations that were anticipated from the adoption of selective methods of admission. The number and national distribution of applicants have increased; the percentage of failures has fallen from 41.47 per cent in 1927 to an average of 23.98 per cent for nine years (1928-29 to 1936-37) and to 15.6 per cent for the first year class in September, 1937, despite the fact that standards of marking in the Law School have been raised. The net results of the experience appear to be that a student with a college average of B or above is a safe risk and for students below this average the capacity test serves as a valuable check. That there is still a range of uncertainty is indicated by the facts that some students—a small number, it is true—who have a high college record do not succeed, and that students who obtain a low score on the capacity test are likely to maintain the required law school average. These facts bear out the statement made by the Dean of the School of Law at Columbia Univer-

sity in his Report for 1928 that "An excellent college record indicates both capacity and industry, but a fair record does not necessarily indicate the lack of these qualities. Some of the best law students have been men who did only fair work in college because of lack of interest or because of extracurriculum activities. On the other hand, it is not unusual for a student with a good college record to fail in law school."¹³

In 1937 the School of Jurisprudence of the University of California adopted the use of a legal aptitude test for purposes of admission. According to Dean Edwin D. Dickinson it began to be felt that quantitative requirements for admission in terms of two or more years of college education had not proved to be a sufficient test of capacity or fitness for professional training in law. Such requirements ought to be supplemented by qualitative tests of capacity. After a period of experimentation for approximately five years, with batteries of tests including the California Legal Aptitude Tests prepared locally, the School of Jurisprudence announced in 1937 that "in 1938 admission would be gained in either of two ways: (1) applicants presenting a bachelor's degree in an approved course from an approved college and having a grade-point average of 1.5 (C+ average) in the work of the last two undergraduate years would be admitted as soon as satisfactory reports in response to a character in-

¹³ For the Columbia University School of Law experience since 1928 see the *Report of the Dean of the School of Law with the Report of the Faculty Committee on the Selection of Students for the Period Ending June 30, 1931*; and the similar *Report for the Period Ending June 30, 1937*.

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quiry could be obtained; (2) applicants otherwise qualified but having a scholastic average of less than 1.5 in the work of the last two undergraduate years would qualify for admission by achieving satisfactory ratings in aptitude tests and a comprehensive interview."

The new system of selective admissions was applied in 1938 in admitting the first-year class with a substantial improvement in quality. Of 135 students admitted in 1936 only 43.7 per cent had a 1.5 average or better in college; of 155 entering in 1937 only 61.3 per cent had this average or better; but in 1938 of 102 entrants 80.4 per cent had a 1.5 average or better. The percentage of those admitted with a 2.0 average (B) or better rose from 17 per cent in 1936 to 27.7 per cent in 1937 to 33.3 per cent in 1938. The number of failures decreased as the scores of entrants rose. Of the 135 who were admitted in 1936, 14 withdrew before the first semester examinations and 26 were disqualified following those examinations; of the 155 entrants in the following year, 12 withdrew before and 34 were disqualified after the first semester examinations; in 1938, of the 102 admitted, 6 withdrew before and 9 were disqualified after these examinations. It is hoped that the number of failures and therefore the number surviving to the end of the course will be affected in the same way, and that "the disappointment, disillusionment, and waste that usually accompany disqualification and withdrawal will have been reduced, if not largely eliminated."

The system of selective admissions has apparently operated so successfully that for the class admitted in

1939 the required grade-point average for admission was raised to 2.0 (B average) in the work of the last two years of college, while those with an average of less than 2.0 must have achieved satisfactory ratings in aptitude tests and a pre-admission interview. "It is anticipated that a substantial group will qualify for admission by the latter method." This "cautiously circumscribed plan of selective admissions" was adopted for the reason that "Wherever the matter had been adequately tested, it had been demonstrated that there was a striking correlation between first-rate achievement in pre-legal preparation, satisfactory work in law school, and measurable success in practice. It seemed clear beyond controversy that either the School must be burdened with an increasing number of students who had turned to it chiefly because they could not meet the requirements of other professional schools, thus failing in its responsibility to the state and to the profession which it is organized to serve, or that it must march in step with the trend toward more discriminating requirements."¹⁴ Among these discriminating requirements the further development of tests of legal aptitude is occupying the attention of the officials of the School of Jurisprudence.

The discussion of admissions by college record and legal aptitude tests in California appears to indicate a renewed interest in methods of selecting students for the

¹⁴ This account is based on the report of a Sub-Committee for Northern California on "Correlation of Aptitude Tests and Legal Training" to the Committee on Cooperation between the Law Schools and the Bar, Northern California (December 10, 1938), and a letter from Dean Edwin D. Dickinson, dated March 10, 1939, and contained in a circular of the University of California Law School Association.

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legal profession. The problem was again brought to the attention of those concerned in legal education in a "Report of the Committee on Cooperation with Bench and Bar" presented at the meeting of the American Law Schools Association in December, 1938. The Committee urged that in determining fitness for admission attention should be directed to character, natural ability, general education, and legal education. In the opinion of the Committee natural ability is of first importance and may make a good lawyer even though both general and legal education up to the time of admission to the bar is limited. Conversely even though a candidate may have had an extensive education, hope of success without natural ability is slight. The minimum general requirements set up by the American Bar Association of two years of college education have been shown by the Pennsylvania Study of the Carnegie Foundation to mean very little. Bar examinations again test a candidate's knowledge of rules of law rather than his general education or natural ability. The question in the opinion of the Committee is, "Shall we not first consider how many students in law schools are really qualified for the study of law and how many graduates of law schools are well qualified for admission to the bar?" Limitation of numbers or the adoption of quotas as a matter of policy can only be effective if the total number admitted to the study of law or to the bar is limited. "If proper standards were maintained, and only well qualified students were admitted to the bar, there would be no need for arbitrary quotas." In improving these standards "can we not use tests in the

college work and aptitude tests as means of selection of capable law students?"

Examining boards in different states might register candidates for the study of law on the basis of their high school and college records, the results of tests on their college work, and scores on aptitude tests. Such a method would not be a quota system but a means of selecting those best qualified for the study of law and of preventing overcrowding the profession. Such a system would not be undemocratic; "rational democracy will afford opportunity for everyone to attain to any office he desires, but will require him to be properly qualified for the office he seeks. This idea is, indeed, essential to successful democracy."

The Committee recommended that the Association devote a session in 1939 to a discussion of the problem, "namely, the advisability of requiring registration before beginning the study of law, and, as a prerequisite to this registration, the desirability of examinations covering the applicant's general education; the advisability of a national board for conducting these examinations; the possibility of developing satisfactory aptitude tests; and the possibility of procuring the cooperation of national and state associations in getting this requirement established." Should this recommendation be adopted, it may mean the adoption of aptitude tests for admission to the study of law comparable to the aptitude test now in use on a national scale for admission to the study of medicine. The development and adoption of objective tests of aptitude would prevent, as Dean C. E. Clark,

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formerly of Yale University School of Law, implied in his discussion of this report, the introduction of arbitrary quotas and would provide substance to the term "well qualified" which may otherwise be meaningless if standards are not clearly defined, objective, and comparable.¹⁵ As Dean Clark has pointed out elsewhere, "One great reason for preliminary selection should be that greater aid can be given to those whose capabilities are found to deserve it."¹⁶

The reports of experiments with aptitude tests for admission to law schools have not resulted in as widespread acceptance as those of experiments with medical aptitude tests for admission to schools of medicine. Of the few institutions which have tried an aptitude or capacity test the majority have abandoned it and have returned to the college record as the most important basis of selection. Confidence in the reliability of such records, unless they are carefully weighed, has been shaken by the report of Dr. W. S. Learned and Dr. Ben Wood on *The Student and His Knowledge*,¹⁷ which revealed the great variability among students and colleges in one state. The question is still further complicated by the results of a number of studies which seem to indicate that the length of college education is not a wholly reliable forecast of success and that students with but two years of college are

¹⁵ For the Report of the Committee and discussions see *American Law School Review*, Vol. 9, pp. 221 ff., 1939.

¹⁶ "Bar Admissions and the Law Schools," *Illinois Law Review*, Vol. 33, p. 907, 1939.

¹⁷ Carnegie Foundation for the Advancement of Teaching, Bulletin Number Twenty-nine. New York, 1938.

likely to do as well as, if not better than, those with three or four years, or that the fourth year of college may not in fact be an asset.¹⁸

A comparison of the experiences with aptitude tests in law schools and in schools of medicine leads to an examination of the reasons for widespread acceptance in the one case and apparent skepticism in the other. In the case of medical schools the use of the aptitude test has had the support and encouragement, after the first few years of skepticism, of the American Medical Association and the Association of American Medical Colleges. This support has made possible the maintenance of a central committee to construct and improve the test and to keep watchful oversight of the results from year to year. In the field of legal education each school has experimented in its own way; except for one study covering eight institutions, and even then with numbers too small to warrant authoritative conclusions, there has been insufficient cooperation. The control of legal education as compared with medical education is not too rigorous; the public cannot become as disturbed about the absence of standardization as it became over such absence in the medical schools when revealed by Abraham Flexner. The facts

¹⁸ See Fraser, E., "Academic Preparation for Law School," *Illinois Law Review*, Vol. 26, pp. 797 f., 1932; Eagleton, W. L., "Academic Preparation for Admission to a Law School," *ibid.*, pp. 607 ff.; Eagleton, W. L. and Henry, N. B., "The Admission and Retention of Students in Law School," in Reeves, F. W. and Russell, J. D., *University of Chicago Survey*, Vol. 5, Part 5, pp. 247 ff., University of Chicago Press, 1933; Luker, L. J. and Douglass, H. R., "Two, Three or Four Years of Pre-Law College Training," *School and Society*, Vol. 45, pp. 383 ff.; Murray, F., "Requirements for Admission to Law Schools," *Kentucky Law Journal*, Vol. 26, pp. 290 ff., 1937.

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that experiments with aptitude tests have not been conducted over large enough areas, that institutions are more or less self-contained, and that in the past, though not so much today, a high percentage of failures has been regarded with pride as evidence of high standards, may all have contributed to a certain indifference about standardization of devices for admission. Finally, it is perhaps more than a coincidence that interest in an aptitude test began to wane after Dean Wigmore published the results of his use of it and concluded after testing only fifty volunteers that "in short the way to find out whether a boy has the makings of a competent lawyer is to see what he can do in a first year of law studies." Those who read Dean Wigmore's conclusions may have failed to read the rebuttals which followed from experts in testing.

It is also not unlikely that the *Annual Review of Legal Education*, published in 1933 by the Carnegie Foundation, had something to do with the situation. In discussing Student Selection the *Review* offered as a solution the suggestion of selection by trial and error in place of selection by trial or experiment. This suggestion was undoubtedly misinterpreted. As defined by Dr. A. Z. Reed, the author of the *Review*: "It is important to note, however, that the method (i.e., trial and error) involves more than correction by an individual of his own error—his realization, after sad experience, of his mistake. It implies the intervention of some external agency, to prevent him doing as he would like. A fuller, though more cumbersome, description of the method would be

that of 'trial by the individual, subject to subsequent correction by authority'." Such a suggestion does not exclude the use of an aptitude test or any other device for selection. All that it seems to imply is that a candidate should be permitted to try himself out, say, in law school but with prior information as to his chances of scholastic success. This, of course, raises another issue than justice to the individual. Dean Wigmore's conclusion would simply involve a waste of at least one year and of money for the individual student; the suggestion that any student be allowed a trial but that he should be definitely forewarned would involve the same waste to him, as well as to the institution, unless it be assumed that accommodation in classrooms and libraries is elastic, and to other students who on the basis of adequate selective devices are certainly likely to succeed. It would mean, further, large classes, catering to the mediocre student, and ultimately a lowering of standards.

That justice demands adequate guidance from as early a stage in the educational career as is relevant is beginning to be generally accepted; that there should be an adjustment between numbers admitted to a profession and social needs is also clear, although the profession itself is not usually in the best position to determine this; that professions have an obligation to society for the maintenance of sound intellectual and ethical standards is equally true. Increasingly the safest guarantee, even though one hundred per cent of reliability can never be expected, is the incorporation into a system of guidance of such devices as possess the greatest predictive value. It

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an hardly be claimed that this stage has yet been reached in the provisions for admission of students to the study of law.

Engineering

THE DEVELOPMENT AND APPLICATION of tests to discover ability to study engineering have had a longer history than either medical or legal aptitude tests. This history has, however, been chequered; it began immediately after the first world war mainly because of the results achieved by engineers in the Army tests; it opened with a great deal of enthusiasm which has led to the production of more types of aptitude tests than are available for any other profession. Unfortunately research undertaken in this field has not been continuous and consistent, despite the fact that it has had the blessing of the Society for the Promotion of Engineering Education (S. P. E. E.) and the Engineers Council for Professional Development (E. C. P. D.). The work has been sporadic and conducted by individuals or in separate institutions. In most cases the tests used or the studies made have been concerned with students after admission to schools of engineering rather than before, although correlations have been made with scholastic records antedating admission.

This situation is all the more surprising because there has been made available more information about the

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qualities desired in an engineer than about those desired for practitioners of other professions. In the extensive *Investigation of Engineering Education*, conducted for the S.P.E.E. by Dr. William E. Wickenden, it was stated that "a complete program of engineering education must include three characteristic techniques, one for the control of nature, one for the direction of men, and one for the appraisal of values. . . . A true professional discipline deals not only with science and technique, but also with the personal attitudes, the ethical traditions and the functional responsibilities in society which give the profession its distinctive hallmark."¹ Dr. W. V. Bingham describes engineering as a science and an art which require skill in organizing and directing human activities, and understanding of natural forces and materials to be controlled. The basic aptitudes involved in engineering are precision in measurement, mathematical competence, and knowledge of statistics, properties of materials, scientific laws and principles, and money values, as well as a sense of the feasibility and worth of what is undertaken and ability in human management; to these are added visualizing aptitude and mechanical intelligence, and, finally and over all, personality.² Personality as defined by another writer includes qualities that make for all-round effectiveness—imagination, adaptability, resourcefulness, dependability, cooperativeness.³

¹ S.P.E.E., *Report of the Investigation of Engineering Education, 1923-29*, p. 63. Pittsburgh, 1930.

² Bingham, W. V., *Aptitudes and Aptitude Testing*. New York, 1937.

³ Curtis, G. B. and Stoughton, B., "Control and Stabilization of Enrollment," *Journal of Engineering Education*, Vol. XXIX, p. 591, April, 1939.

ENGINEERING

Not only have the qualities desirable for the practice of engineering been studied and analyzed, but the need of some adequate methods of selecting prospective candidates has also secured wide recognition. The Wicken-den Investigation reported that fewer than 40 per cent of students who entered engineering schools survived to graduate as a result of indiscriminate methods of admission. The cause of more than 50 per cent of the failures was scholastic failure; other causes were health, finance, and change of courses. The scholastic failures were due to lack of preparation in a particular field, as, for example, mathematics, rather than lack of native ability or vocational aptitude; no evidence is, however, produced for this conclusion. The necessity of devising adequate standards of selection is stressed as a duty to the engineering profession, the industries, and the public. The mortality in institutions giving engineering education is shown by the progressive decline in the numbers enrolled each year in 115 institutions reporting in 1936; the figures were as follows: First year, 23,058; second year, 15,842; third year, 12,528; fourth year, 9,781. Figures such as these are evidence of either poor selection of students initially, or unsuitable curriculum organization and standards of marking within the course, or both. Wherever such evidences of misfits or of maladjusted students are found, they point to the need either of more adequate methods of selection, or of clearer methods of guidance and publicity. The S. P. E. E. has devoted a good deal of attention to the latter, but, beyond the expression of pious intentions, has not promoted any concerted cooper-

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ative attack on the problem, as was done by the Association of American Medical Colleges and the American Law Schools Association. In 1931 a list of projects suggested by the S. P. E. E. to schools of engineering for experimentation included: (1) development of tests of aptitude for engineering; (2) development and trial of selective tests as an adjunct to admission by certificate; and (3) determination of causes of failure and elimination.

Despite this apparent interest the Committee on Tests and Comprehensive Examinations of the S. P. E. E. could still state in its Report, presented at the Forty-fourth Annual Convention of the Society, that "some engineering teachers in commenting on administration of tests under the auspices of this Society, have expressed the opinion that the attitude of the Society in the past has been to suggest and encourage the administration of groups of tests, and then let Society interest lapse in the test results and their use." The responsibility cannot, however, be placed altogether at the door of the Society; the institutions themselves are often guilty of gathering data of some kind about their students and of failing to provide for their proper use.⁴

There is no doubt that the need of some selective devices has been recognized; yet in a very recent statement doubt was expressed on the feasibility of developing such

⁴ See Report of the Special Committee of the S. P. E. E. for 1930-31 on "Personnel Methods in Use in Engineering Schools," *Journal of Engineering Education*, Vol. XXII, p. 754, 1931-32; and Harding, G. H., "Correlation of Freshman Placement Tests with Scholastic Achievement," *ibid.*, Vol. XXVIII, p. 736, 1937-38.

devices at present. "We do not know what engineering aptitudes are . . . We do not know how to examine a prospective engineer, nor what our tests really reveal. We are on insecure footing in trying to explore minds by any tests we have yet established." And yet it is admitted by the same writer that "It does almost seem that the bridge engineer is more troubled by excessive wastage than we are in our heavy losses during our process of training." It is necessary to find out what a person can do best and then to bend every effort to his development. This would mean less economic loss, less loss of self-respect, psychological poise, and stability. "But we do not have a sufficiently positive selectivity . . . Our selections are made with sieves rather than with magnets." ⁵

One difficulty in the situation arises from a confusion as to the purpose that a professional aptitude test is to serve. No one has claimed, and it would be foolish to claim, that any aptitude test can predict ultimate professional success; all that it can be expected to predict is success in a well-defined course of professional preparation. As stated in a Report of the Committee on Objectives and Length of Curriculum of the S. P. E. E., "most of us feel at least a degree of confidence in estimates of performance in a future portion of a college program, based on actual performance in a past portion." ⁶ For "the college of engineering shares with the college of medicine the responsibility of training men for public service. Therefore, it must hold up exacting standards of

⁵ Ferguson, O. J., "Vocational Guidance and Student Selection," *Journal of Engineering Education*, Vol. XXIX, pp. 614 f., April, 1938-39.

⁶ *Proceedings of the S. P. E. E.*, Vol. XLIII, p. 116, 1936.

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achievement for those to whom it gives its stamp of approval. However, in the interest of sound educational guidance, the college of engineering may well consider methods of reducing its rate of scholastic mortality and directing the efforts of the unfit student into channels which promise greater personal and social growth.”⁷

The earliest “attempt to sort out the more promising methods of investigation from those that prove to be less fruitful” in the selection of students was that made by Professor E. L. Thorndike in connection with the study of engineering education conducted by Dr. Charles R. Mann. The experiments were made with freshmen in engineering at Columbia University, Massachusetts Institute of Technology, the University of Cincinnati, and the Wentworth Institute. It was found in general in this experiment that seven of the original fifteen tests used gave a closer correlation with the composite school marks than did the composite of all fifteen. What is important in this study is that of the seven tests five were in mathematics and two in supplying missing words from sentences.⁸

The Thorndike experiment was followed by another experiment by Professor L. L. Thurstone with the application of a test to students in forty-nine engineering and other colleges. The test covered problems in arithmetic,

⁷ Feder, D. D. and Adler, D. L., “Predicting the Scholastic Achievement of Engineering Students,” *Journal of Engineering Education*, Vol. XXIX, p. 385, 1938-39.

⁸ Mann, C. R., *Study of Engineering Education*, pp. 49 ff. and 117 ff. Bulletin Number Eleven of the Carnegie Foundation for the Advancement of Teaching.

algebra, geometric construction, physics, and technical information, and a psychological test. The results published in 1923 showed a correlation between the test and scholastic achievement ranging from .30 to .40. Although Thurstone's tests were continued and applied to college students in general under the auspices of the American Council on Education, little further work was done directly along these lines with engineering students, possibly because another experiment undertaken in connection with the national Investigation of Engineering Education revealed a test which showed higher correlations.

In 1924-25 and 1925-26 an experiment was undertaken by Dr. H. P. Hammond and Dr. G. D. Stoddard to study the usefulness of the Iowa Placement Examination in engineering colleges. More than 8,000 students distributed among forty-five engineering colleges took the English Aptitude Test, 1,300 the Physics Training Test, and 1,000 the Mathematics Test. The purpose of the experiment was to discover whether a scholastic aptitude test was useful as a means of predicting probability of success in the engineering courses. "Since scholastic ability is a permanent quality, any instrument that measures factors contributing to success in the freshman year will also be indicative of success in the later years of the curriculum, but not in the same degree owing to the operation of other factors beyond the scope of educational measurement."

The correlation between composite scores in the entire series of Placement Tests and general success in the work

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of the freshman year was available only for those few institutions which administered the entire group of tests; the composite scores showed a correlation of .65 to .75 with the general academic work of the first semester of the freshman year. The study revealed a great range of aptitude and preparation among entering students both for scholastic work in general and for specific studies. Placement examinations appeared to be valid instruments for predicting scholastic achievement in engineering colleges—best as to the highest ranking students, good for the lowest ranking students, and lowest for students near the middle of the group. The examinations predicted adequately for the purpose of differentiating the ablest and the poorest students; although not intended to predict success beyond the first year, they did offer good prediction of survival through the course. In any event the results of the examinations offered valid data for sectioning students, for case histories, and for remedial measures. At the Case School of Applied Science with an unusually homogeneous and well-prepared body of students no student in the highest fifth in the Iowa Placement Examination scores failed to complete the course because of scholarship; three-fourths of those so placed entered the senior year, while three-fifths of those in the lowest fifth on the scores were dropped because of poor scholarship. The predictive value of the Iowa Placement Examination was found to be as good as that of first term grades.⁹

⁹ S. P. E. E., *Report of the Investigation of Engineering Education, 1923-29*, pp. 688 ff. Pittsburgh, 1930.

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The subsequent development of the use of tests of some kind increased rapidly after the publication of the report of the S. P. E. E. According to this report (*Report of the S. P. E. E. Committee on Tests and Comprehensive Examinations*, 1936), 24.5 per cent out of 94 institutions giving instruction in engineering gave at least one test in 29; in 1936 it was found that over 78 per cent of these institutions were administering one or more tests to measure the preparation and ability of entering students. By this time the tests used were either the Iowa Tests or the Cooperative Tests or both; a few gave some other tests, usually one of the standard psychological tests, with or without the two mentioned. The purposes for which tests were used varied considerably; only six of the 94 institutions employed them for selective admissions; the other purposes included vocational guidance, prediction of graduation, diagnosis and remedial measures, job placement, exemptions, and sectioning in different subjects.

There is no doubt whatever that there are available a large number and a great variety of tests—general psychological, scholastic aptitude, placement, special engineering aptitude tests, and tests of visualization or spatial relationship. But the availability of the tests offers no clue to the range of their use; they do not appear to have been arranged in batteries which would serve as a measure of something which may be called a test of aptitude for the study of engineering. The reasons for this are perhaps to be found in another direction, the clue to which is in studies already made of the type of scholastic

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ability which shows promise of success in engineering courses.

In a report on "Some Facts about the Scholastic Achievements of Engineering Students" ¹⁰ H. W. Miller and J. C. Palmer of the University of Michigan found in a study of high and low students during a three-year period (1923-26) that "the first semester index of the students' prospects in college is as nearly perfect as one could wish. To all intents and purposes the curves [for first semester grades and total grades] are the same." Of 149 students classified as low 19 graduated; of 130 who withdrew before graduation only two left with a total average as high as 2.0 on a five-point scale of marking or C on a literal scale. Of the high men 73 per cent graduated, and 23 per cent left of their own accord. The investigators raise the question on the basis of their findings, "Why do we permit such students [the ultimate failures and withdrawals] to continue so long in college after they have demonstrated their possibilities so clearly?" The high and low students can be quite accurately selected during their first year in college. The paradoxical discovery that "the low and middle students show a marked improvement, while the high students show a steady decline" during the course, raises the question "Are we so much concerned in salvaging the inferior and mediocre as in developing our finest material?"

The conclusion reached by A. Dvorak and R. C. Salyer after a study of the "Significance of Entrance Requirements for the Engineering College at the University of

¹⁰ *Journal of Engineering Education*, Vol. XXI, pp. 371 ff., 1930-31.

Washington”¹¹ is as follows: “Clearly, of the data available at the time of matriculation in the Engineering College at the University of Washington, those most significant of the students’ success are the high school natural science and the high school mathematics averages and the Iowa Mathematics Test and Iowa Physics Test scores. The student’s high school natural science score is 15.2 times as significant as his social science record. The rating the student makes on the Iowa Physics Test is 7.3 times as significant as is his high school social science record.” The study took into consideration intelligence test scores, chronological age, total high school record, high school record in special subjects, aptitude tests, objective tests in special subjects, objective tests over the whole high school course, special interest tests, and the essay type entrance examinations.

Starting with the recognition of the importance of mathematics in engineering studies T. J. Higgins of the School of Engineering, Cornell University, conducted a “Study of Mathematical Ability in Relation to Success in Engineering Studies”¹² in which he found that the scholastic averages of 153 students decreased with a decrease in mathematics averages; the correlation between mathematical ability and success in engineering studies was .84. “It would be a most interesting study,” he concluded, “and a most valuable one to determine the relationship between the success of the engineering student in school and his work in secondary mathematics. If a

¹¹ *Ibid.*, Vol. XXIII, pp. 618 ff., 1932–33.

¹² *Ibid.*, pp. 743 ff.

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definite positive relationship could be found between these two, then we have a sure way of picking those applicants that will have the best success in the engineering schools." C. W. Boardman and F. H. Finch, after an examination of the complete high school records of 139 students who entered the College of Engineering and Architecture of the University of Minnesota in 1934, found that students who offer extensive training in high school science, mathematics, and manual training are somewhat better prospects for success than those who have had slight contacts with these subjects. This study indicates, for purposes of selection, that students of these subjects have on the average more ability for or interest in the types of material met in engineering courses.¹³

At the annual meeting of the S. P. E. E. held in Madison, Wisc., in 1936, R. L. Sackett reported that in 1934 the Engineers' Council for Professional Development gave the Cooperative Tests in English and mathematics to 1,900 students who entered eight engineering colleges and to nearly 3,000 entering students in twelve colleges in 1935. The mathematics test showed a correlation of .57 with the average grade at the end of the first year and .52 at the end of the second; the English test resulted in a correlation with average grades in the two years of .45 and .37, respectively. "It seems safe to say," was the conclusion, "that a good mathematics test has selective value for engineering students." Equally favorable was a report at the same meeting of the predictive

¹³ Boardman, C. W. and Finch, F. H., "Relation of Secondary School Preparation to Success in the College of Engineering," *Journal of Engineering Education*, Vol. XXIV, pp. 466 ff., 1933-34.

value of the grade obtained in descriptive geometry, which showed as high a correlation as any other test with a student's average for the first year and for the four years.¹⁴

In a report on a study of the relation of ability in physics and mathematics to capacity for engineering education, conducted over a period of ten years (1921–1931) with students at the College of Engineering of the University of Akron, F. E. Ayer showed that the largest percentage (39.5 per cent) of those who graduated failed in neither mathematics nor physics in their first semester, while only 2.6 per cent of those who failed in both subjects graduated. "Our conclusion," wrote Dean Ayer, "is that engineering students who can not, or will not, pass mathematics and physics in their first semester, had better transfer to some other department."¹⁵

After administering placement tests for eight years a definite relationship was found at the Speed Scientific School between mathematics-science averages and scholastic achievement. Tests were given in the early years of the investigation, beginning in 1930 in English Aptitude, English Training, Mathematics Aptitude, Mathematics Training, Chemistry Aptitude, and Physics Aptitude. A psychological test was also given but not continuously. It was found that the English Aptitude Test was of no use in predicting fitness in mathematics, chemistry, and physics, and was dropped from the com-

¹⁴ "College Hurdles," *Proceedings of the S.P.E.E.*, Vol. XLIV, pp. 286 ff., 1937.

¹⁵ "Physics, Mathematics and Engineering," *Journal of Engineering Education*, Vol. XXVIII, pp. 502 ff., 1937–38.

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putation, although records were kept. The percentages in tests other than English were averaged as mathematics-science averages. The general conclusion was that students in the fourth quartile in incoming classes should be informed that the probability of completing the required courses in four years was negligible, so that, without being excluded, they should from the start understand that the odds of ultimate success were against them.

A study of the records of students entering the College of Engineering of the University of Iowa in September, 1931, showed that out of 108 students 99 remained one semester, 84 at least one year, and 26 graduated in July, 1936; 9 dropped out for reasons of health, finances, and so on. Freshmen in the College of Engineering take the Iowa Qualifying Examination, which includes the Iowa High School Content Examination, Iowa Silent Reading Test, and the Mathematical Aptitude and English Training Tests of the Iowa Placement Series. The tests taken individually and as a battery have satisfactory validity for predicting first year achievement, with a range of coefficients between .40 and .60. Because of the more specialized nature of engineering subjects experiments were conducted to discover whether a special combination of tests might yield better predictive results than the entire battery. It was found that if prediction alone were the criterion a combination of the Iowa High School Content Examination and the Mathematics Aptitude Test would be the simplest and most efficient battery, the other tests being retained mainly for diagnostic informa-

tion. The general conclusion was that the Mathematics Aptitude Test appeared to be the best single measure, yielding predictions for actual numerical grade averages 31 per cent better than chance for the first semester achievement. The inadequacy in abilities and preparation of nearly three-fourths of the group of 108 students who did not remain to graduate could have been determined before a semester or a year of failure.¹⁶

The general trend of the investigations seems to indicate that at present mathematical ability is the best measure for predicting success in a college engineering course. Since there is evidence that ability in mathematics is generally a good predictive test of scholastic ability, the question still remains whether it does actually serve as a test of engineering aptitude, and whether the wide range of other tests which have been used can safely be ignored. The question was well stated in the *Report of the Committee of the S. P. E. E. on Tests and Comprehensive Examinations*: "The lack of an adequate philosophical concept of engineering aptitude appears still to be a great obstacle to measurement of engineering students. We have not gotten away from the idea on the one hand that the psychological test *per se* must be used in such programs. On the other hand, there are still those who think that the engineer is 'born, not made', and that the tests must show some mystical 'engineering aptitude' that students in other schools do not have. There needs to be

¹⁶ Feder, D. D., and Adler, D. L., "Predicting the Scholastic Achievement of Engineering Students," *ibid.*, Vol. XXIX, pp. 380 ff., 1938-39.

formulated and stated as a basis of further testing by engineering colleges a scientifically sound, comprehensive notion of engineering aptitude.”¹⁷

Despite the evidence which points to the predictive value of a mathematics test, there appears to be a widespread opinion, voiced in the same *Report*, that no single test will with any certainty demonstrate fitness for engineering study and practice. “A complete all-round picture of the student is what is needed, and this is to be secured by administering not one, nor two, but many tests. . . . The more tests given the clearer idea of students’ abilities will be obtained. . . . What is needed is a comprehensive scheme of differential measurement, based on a generous battery of aptitude tests, supplemented by such other measures of attitude, personality, character, financial means, parentage, interests, and other factors as can be constructed and scored by objective means.”¹⁸

It is quite possible that, when the suggested experiments with a generous battery of tests and other measures have been tried out, it will be proved that mathematical ability is still the best predictive measure. All that can be said at this stage is that studies and investigations which have been conducted so far and on which reports have been available have been conducted in individual institutions and with relatively small numbers of students. Further, they have been conducted in the first semester after students have already been admitted. If tests which are genuine tests of engineering ability can

¹⁷ *Proceedings of the S. P. E. E.*, Vol. XLIV, p. 504, 1936.

¹⁸ *Ibid.*, p. 505.

be constructed and validated, they could and should be used in advising students before they are admitted to an engineering college. To prove that the result of a mathematics test shows a high correlation with success in the engineering course is of little help in reducing the number of students who fail to graduate. Tests administered after students are admitted and the results thereof remain an interesting academic exercise until they are used practically in the guidance of applicants for admission. The question whether students should be denied admission on the basis of test results still remains an open one to be determined by standards of fairness to the students, the profession, and the public. The students should at least be warned in advance of entering a professional school what their chances of success in the chosen course are. A sound system of guidance, on which the S. P. E. E. and the E. C. P. D. have already embarked, should enable the students to reach a decision for themselves when they are informed of their chances.

The problem is not one that can be solved by individual institutions in isolation or by research workers in such institutions. Guidance is meaningless unless it can be supported by convincing evidence of aptitude or the lack of it. It is for these reasons that the present study may well close with still another quotation from the *Report of the S. P. E. E. Committee on Tests and Comprehensive Examinations* (1936) as follows: "In view of the pronounced interest which the S. P. E. E. has in determining the precision with which engineering aptitude and academic success can now be predicted, it would

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seem to be a vast waste of time and effort on the part of students taking the tests and of staff and teachers in scoring tests, if this Committee or this Society does not now assemble these data and make the comprehensive study of scholastic and engineering aptitudes that these data, once collected, would permit of doing. No such waste as this would be tolerated at all if it related to actual engineering construction work. Your Committee is strongly of the opinion that the Society could with profit assist it in securing funds necessary to make such a study of these data. There would seem to be little point in again encouraging administration of a new set of tests, as the E. C. P. D. is now doing, if results are to be scorned as they have been both in respect to the Thurstone and the Iowa Placement Tests. There is a field of study here that a committee of teachers within the colleges can do far more effectively, because they are in direct contact with this testing work, than can any extraneous agency set up outside the colleges by the profession.”¹⁹

¹⁹ *Ibid.*, p. 499.

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